FEATURING THE ENERGY CALCULATOR!

Home Heating & Cooling

A Consumer's Guide

Ontario

Acknowledgements

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CANADA MORTGAGE AND HOUSING

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ONTARIO HOME BUILDERS' ASSOCIATION

ONTARIO HYDRO

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Note: All information in this publication was believed to be current as of January, 1993. The information is, however, subject to change.

Contents

Back pocket of guide

THE ENERGY CALCULATOR

A set of easy-to-use tables that will help you determine operating and equipment costs of different systems.

Cette publication est également disponible en français.

How This Guide Can Help You

Are your energy bills too high? Is your home not as comfortable as you want it to be? Do you have teenagers at home giving your hot water bill a beating? Whatever your situation, this guide will help you to find a solution that's right for you.

Are You Building a New Home?

This guide is primarily aimed at homeowners who are thinking of upgrading or replacing their home's existing heating or cooling systems. It also contains useful information for people who are having a home built for them. While builders generally offer a standard heating or heating/cooling package, upgrades to more efficient equipment might be available. Familiarity with the different systems and fuel options (pages 14 to 21), their comparative prices and operating costs (Energy Calculator in the back pocket of this guide) will help you to review upgrade options with your builder. Remember to also ask about other energy efficiency upgrades, which can range from extra insulation to a complete R-2000 package.

For Homeowners This Guide:

- ✓ explores how different heating systems produce heat and distribute it throughout a home;
- ✓ investigates central air conditioning and suggests options to cool your home;
- ✓ explores the efficiencies of different units;
- ✓ helps you make a fuel choice;
- ✓ looks at options for providing hot water;
- ✓ compares the purchasing and energy costs of different pieces of equipment;
- ✓ explains how to go about replacing a system;
- ✓ helps you select a contractor;
- ✓ tells you how to get more information.

Dollars and Sense

After you are familiar with all your equipment and fuel options, and have compared their advantages and disadvantages in the Comparison Shopping section, you'll want to sharpen your pencil and take the Energy Calculator out of the back pocket. The tables show at a glance how the operating cost of your current heating and cooling system compares with those of the latest technologies. They also compare equipment installation costs so that you can decide which option is best for you.

A Wise Choice

The options presented in this guide will help you to select heating and cooling systems that meet the needs of both your lifestyle and your cheque book. But the advantages of investing in energy-efficient systems aren't only felt within your family budget — they are realized in the cleaner environment that goes hand in hand with more efficient systems and the wise use of energy.

For more information on home energy conservation and efficiency turn to page 38.

Before You Start . . .

Putting an energy-efficient heating system into a drafty, poorly insulated house will reduce your energy bills. But you'll notice a more dramatic saving if you also make your entire house more energy-efficient. How? Here are some ideas . . .

Increase insulation levels where appropriate to prevent heat loss in winter and heat gain in summer.

Weatherstrip and caulk to seal air leaks.

Open drapes on south-facing windows on sunny winter days so that the sun's energy can help heat your home, and close them in summer.

Choose energy-efficient products when replacing windows and doors.

By making your house and your lifestyle more energy-efficient, your heating and cooling systems will work less, which translates into more savings for you.

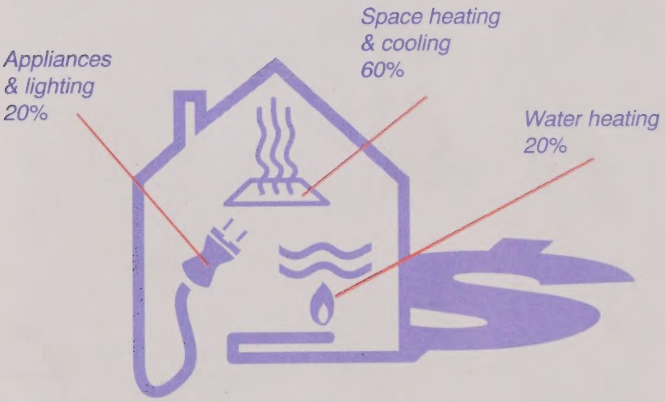
Why Energy Efficiency Matters

It's good for your budget and your comfort. . .

Each year you spend hundreds of dollars to heat and cool your home and to heat your hot water. By installing energy-efficient equipment — which gives you the same comfort for less energy — you can lower these costs. Furthermore, the lower you can make your energy costs now, the better off you will be when energy prices go up.

The Energy Calculator in this guide is updated at least annually to reflect current fuel prices. For energy cost forecast information, see the future fuel cost listing on page 40.

How Your Energy Dollar is Spent*



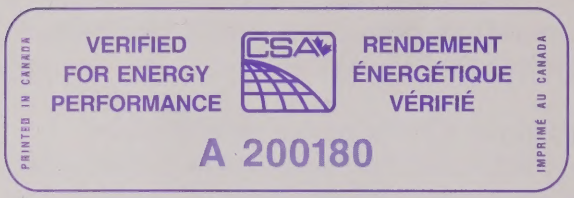
*Based on an average of the three main fuels

It's good for the environment . . .

Whenever combustion fuels are burned in your home, or in generating stations to produce electricity, carbon dioxide, nitrogen oxides and other emissions are released. By changing to more efficient equipment, your home will consume less energy and make less of an impact on the environment.

Energy Efficiency Act

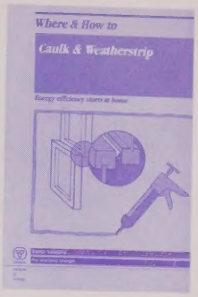
Ontario's Energy Efficiency Act establishes minimum efficiency levels for a wide range of energy-using products. Look for an energy performance label similar to the one below on all these products:



- *electric, gas and oil water heatet*
- *gas and propane furnaces*
- *oil furnaces and boilers*
- *ground source and air source heat pumps*
- *room and central air conditioners*

For more information about the Energy Efficiency Act, contact the Ministry of Environment and Energy at 1-800-ENERGY1.

Are You Serious About Cutting Your Heating and Cooling Costs?



If so, follow these three steps:

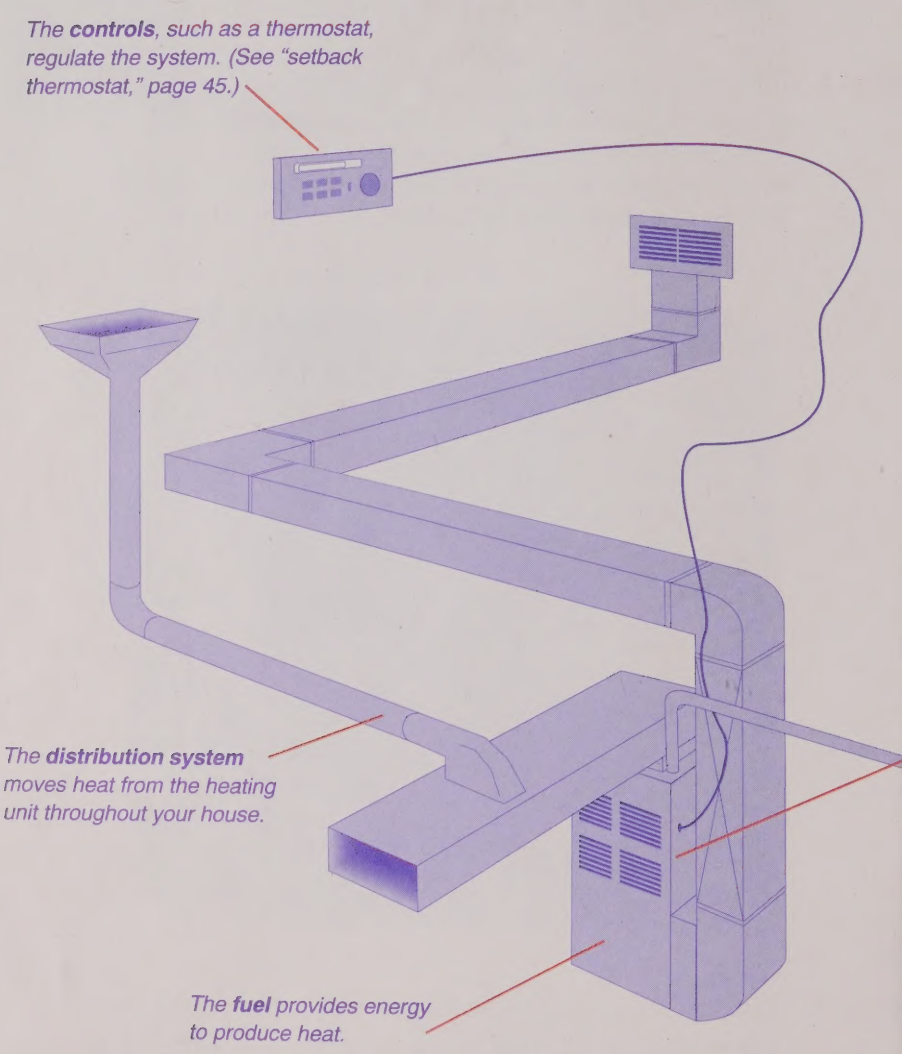
Step 1 Improve the insulation and air sealing in your home. (See page 38 for where to get information.)

Step 2 Use this guide to help you decide what kinds of changes to your heating and cooling systems will be right for you. Remember to review your hot water options at the same time so that your overall system will be as cost-effective as possible.

Step 3 Consult with a registered heating/cooling contractor and your fuel supplier before making a final decision. (See page 32.)

Heating Systems

A heating system often has four main features:



Heating Units

There are four common types of heating units:

- A **furnace** provides heat through a forced air distribution system.
- A **boiler** provides heat through a hydronic distribution system. (Hydronic systems are also referred to as hot water systems.)
- A **space heater** supplies heat directly to the room where it is located.
- A **heat pump** extracts heat from the air, ground or water outside the house and usually delivers it through a forced air distribution system.

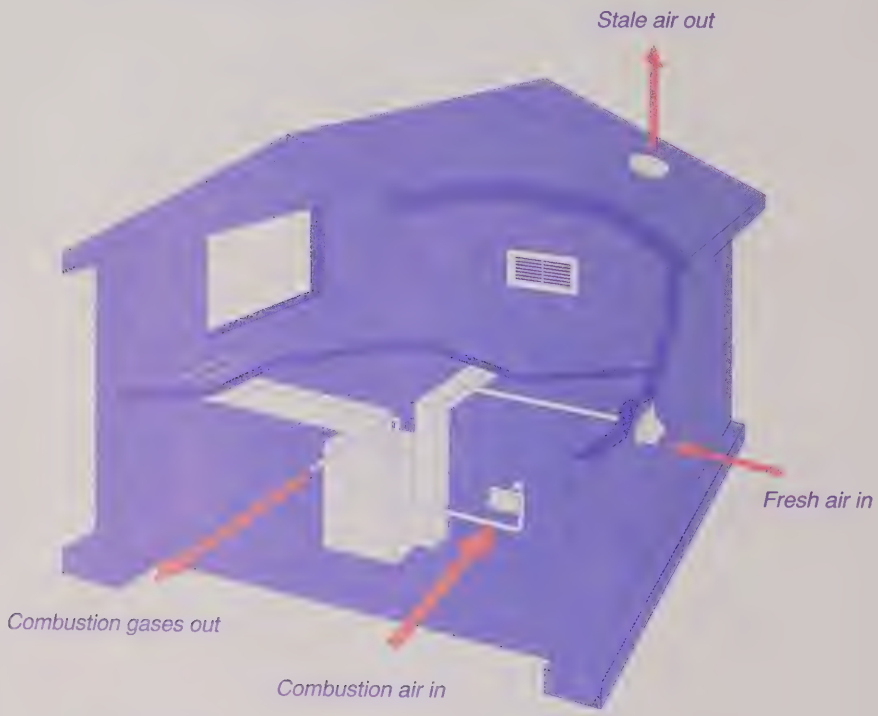
Most Heating Systems Need Air for Combustion

Furnaces, boilers and space heaters that burn fuels need a supply of air to be able to burn properly, and a vent to the outdoors so that combustion gases can escape from the house. Electric heaters do not need to be vented.

*The **heating unit** (such as a furnace or boiler) supplies heat.*

Combustion Air In

In the past, there was usually plenty of air leaking into a house to keep the furnace, boiler or stove burning well. Modern homes, however, are better sealed and use controlled ventilation — rather than uncontrolled leakage — to provide greater comfort and energy efficiency. Vents that supply air for heating units should never be blocked.



Combustion Gases Out

Venting was normally done through a chimney. Today, however, most equipment using natural gas, oil and propane can be vented by pipe directly through the wall, which greatly simplifies installation. Remember that combustion gases cannot escape from your home unless you provide air to replace them. That's why venting problems can often be traced to air supply problems.

A Word About . . . Air Quality

Air pollution can sometimes be worse inside your home than it is outside. As you increase the air-tightness of your home, you must also keep air quality in mind. What to do?

Recognize sources of pollution in your home

Air-borne pollutants are either biological (mould, dust mites, pollen, animal dander) or chemical (gases or chemical particles released by furnishings, carpets, construction materials, unvented appliances, renovation activities including dust from lead paint, poorly maintained heating systems, humidifiers and dehumidifiers).

Your heating system

All heating systems that burn fuels give off combustion gases. Occasionally, a portion of these gases might "spill" into the home instead of exhausting to the outdoors. If you suspect a problem, ask your fuel or equipment supplier to check for combustion spillage and make any recommendations necessary, e.g. installing a combustion air supply or upgrading or replacing equipment.

Is your home well ventilated?

If you are planning to make your home more air tight, be sure to check into the need for improved ventilation. A mechanical ventilation system is a must for any well-sealed home. A heat recovery ventilator goes a step further and provides more energy-efficient ventilation by reducing heat loss as outdoor air replaces indoor air. See the home air quality listing on page 41 for where to get information on ventilation.

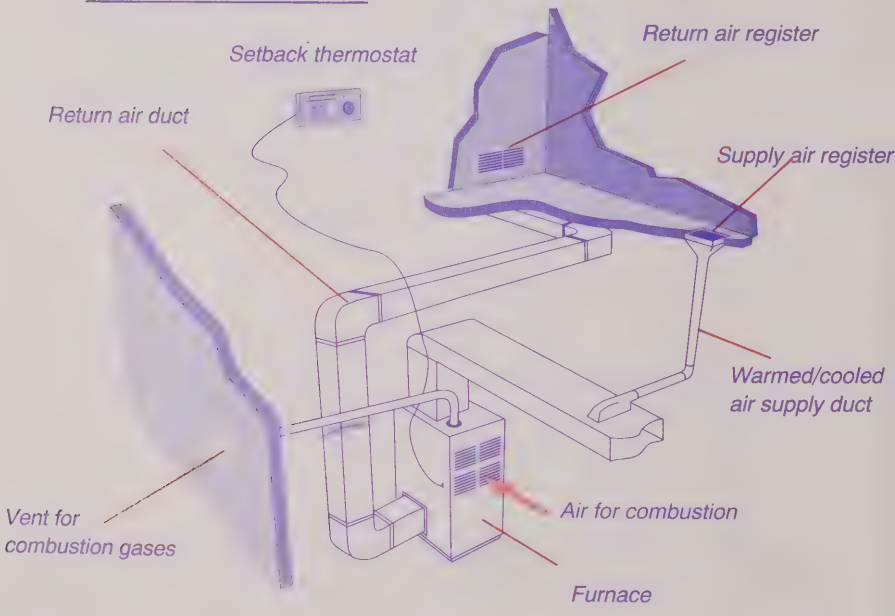
Distribution Systems

There are three types of distribution systems. A forced air system circulates warmed or cooled air around the house through a network of ducts; a hydronic system distributes heat through hot water pipes and radiators; and space heaters, though not technically a distribution system, provide direct heat to the room in which they are located.

Forced Air

The majority of new homes and most existing homes have forced air distribution. Registers in each room can be adjusted to control the air flow. Return registers draw air from the rooms through separate ducts back to the furnace to complete the cycle of flow through the house.

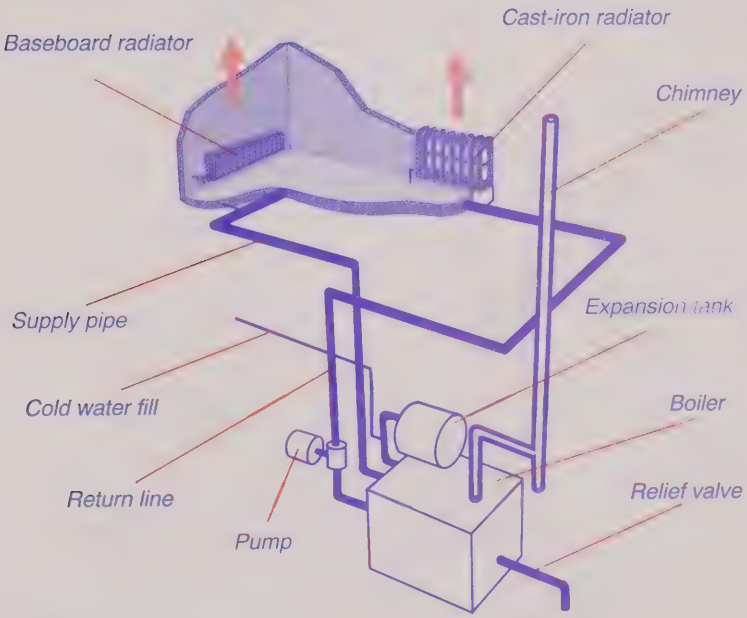
Forced Air Heating System



Hydronic

A hydronic system distributes hot water from a boiler to radiators, convectors or under-floor heating systems in each room. In older homes, large cast-iron radiators are common. Modern systems feature smaller boilers, narrow piping and compact radiators that can be regulated to provide temperature control in each room. Hot water piping can be built into the floors of new homes.

Hydronic Heating System



Space Heaters

These have no central heating unit or distribution system. Instead, individual space heaters — a wood stove, oil, natural gas or propane space heater and electric baseboard or radiant heaters — supply heat directly to the room. For safety, all space heaters except electric ones need to be vented to the outside. An appropriately sized space heater can supply heat to all parts of a home if the design of the home allows for natural distribution of heat from the heater location.

Energy Sources and Equipment Options

Natural Gas

Furnaces in forced air heating systems, boilers in hydronic systems, fireplaces and space heaters can be fuelled by natural gas. It is delivered to your house through an underground pipeline.

Propane

Most equipment fuelled by propane is similar to that fuelled by natural gas. In many cases, the only differences are one or two small components that can often be changed by a registered contractor to convert a unit from one fuel to the other. Propane is delivered by truck and stored in a tank on your property.

Gas Equipment

Because of their similarities, natural gas and propane heating equipment are discussed together. The term "gas" refers to both natural gas and propane. The cost of the two fuels differs, so remember to check the Energy Calculator for cost comparisons. There are three main types of gas furnaces: conventional (with a seasonal efficiency range of 55 to 68 per cent), mid-efficiency (78 to 82 per cent) and high-efficiency (90 to 98 per cent). Gas boilers have similar ranges of seasonal efficiency.

For an explanation of efficiency ratings for furnaces, boilers, heat pumps, air conditioners and hot water heaters see the Efficiency Ratings section.

Conventional gas furnaces and boilers

These older furnaces and boilers require a continuous liner in a masonry chimney or a metal "B" vent chimney because their combustion gases — including water vapour and carbon dioxide — are hot. About 35 per cent of the heat from the fuel goes up the chimney.

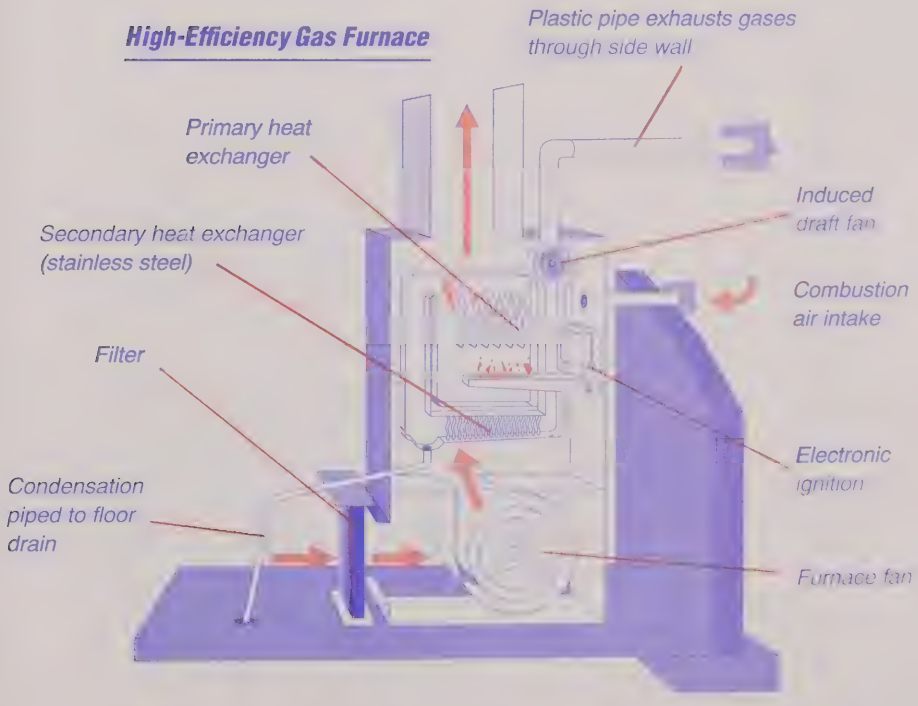
Mid-efficiency gas furnaces and boilers

These models remove enough heat from combustion gases to allow them to be vented through a wall. Some models are designed to vent through a chimney. The improved efficiency of these models means that less heat escapes when the gases are exhausted.

High-efficiency (condensing) gas furnaces and boilers

These models extract so much heat from combustion gases that they can be safely vented through a narrow plastic pipe that runs through the wall.

High-Efficiency Gas Furnace



A Word About . . . Conversions

As indicated, the natural gas and propane equipment is often identical except for a few components. However, conversion of such equipment may only be performed by fitters licensed to work on the equipment involved, and such conversions are only permitted on equipment for which the manufacturer supplies a conversion kit certified by the Canadian Gas Association. At time of printing, there were indications that the requirement for a certified conversion kit might be relaxed for some equipment and the acceptability of conversions, while still requiring a licensed fitter, would be at the discretion of the fuel supplier.

If conversion capability is important to you, confirm the possibility of legal conversion of the equipment involved before you buy.

A Word About . . . Efficiency

Under an Energy Efficiency Act regulation, gas furnaces manufactured after January 1, 1992, and sold in Ontario must have an annual fuel utilization efficiency rating of at least 78 per cent. Conventional gas furnaces, therefore, are no longer manufactured for sale in Ontario, although many are still in use.

Gas-fuelled Fireplaces

Gas fireplaces can be used to provide space heating. Because there can be significant differences in the amount of useful heat provided from model to model, consider efficiency as well as appearance if you are buying one of these units.

Oil

Oil furnaces and boilers have a burner, a heat exchanger and a blower or pump. New oil furnaces made in Ontario are efficient. Oil is delivered by truck and stored in a tank, which is usually located in the basement.

Conventional oil furnaces and boilers

Older, conventional oil furnaces and boilers with a standard burner have a seasonal efficiency generally ranging from 60 to 70 per cent. This can be improved by replacing the burner with a flame retention unit — usually a more cost-effective step than replacing the entire furnace.

New oil furnaces and boilers

A typical new oil furnace or boiler has a seasonal efficiency rating generally ranging from 78 to 86 per cent. Many of these units can be vented through the wall.

High-efficiency oil furnaces

Oil furnaces with seasonal efficiency ratings of 90 per cent or more are now available.

A Word About . . . Upgrading

. An older oil furnace or boiler can often be upgraded to over 80 per cent efficiency. The first step in making a decision about a possible upgrade, or replacement, of your oil furnace or boiler is to have a qualified service technician measure its steady-state efficiency. The technician can explain what should be done to increase efficiency and maintain safe operation. The serviceperson can also estimate the costs of an upgrade, the remaining life expec-tancy of the existing equipment and the replacement costs.

Wood

Over 90,000 Ontario households use wood as their main fuel and a further 200,000 use it as a supplementary source of heat.

Most of these households are outside large urban areas where firewood is usually less expensive than other fuels. Before considering converting to wood heat for economic reasons, however, you should also take into account the need for storage space and the time and effort required to gather and pile the wood and tend the fire. (For information on sources of firewood, see page 40.)

The most common approach to wood heating today is a wood stove or high-efficiency fireplace installed in the main living area of the house. If the house is medium-sized and relatively new, this kind of equipment can provide almost all the heat needed. If you have an existing masonry fireplace, a high-efficiency fireplace insert could be a good option.

Many advanced wood-burning appliances produce one-tenth of the stack emissions and one-third higher efficiency than those built a decade ago. In addition, many models are pleasing to look at and offer all the pleasures of a visible wood fire — something you should keep in mind when you use the Energy Calculator.

Older or larger houses may need the additional heating power offered by a wood-burning furnace. If your present heating system is a forced air furnace that uses a more costly fuel, you might wish to consider an add-on wood furnace. It is installed beside the existing furnace and the duct work is modified so that it can be shared by both furnaces. Combination wood/oil or wood/electric furnaces are options for new or replacement systems.

When shopping for wood-burning equipment, visit several wood heat retail stores and discuss appliance selection, location and installation with a knowledgeable salesperson. Certification under the Wood Energy Technical Training program (WETT) indicates that the salesperson and installer have been trained in the proper, safe installation and operation of wood-burning equipment.

Always buy wood-burning equipment that is certified for safety. Look for equipment labels bearing the names Warnock Hersey Professional Services, Underwriters Laboratories of Canada (ULC) or Canadian Standards Association (CSA). It is also preferable to buy equipment that has been certified as meeting the U.S. Environmental Protection Agency (EPA) or Canadian CSA- B415 emission standards.

Other Fuels

Stoves that burn corn kernels and pellets made from wood or agricultural crops are also now available. Pellets are automatically fed into the burner and a homeowner simply dials in the required temperature on the thermostat. Check the listings on page 40 for information on alternative energy choices.

Electricity

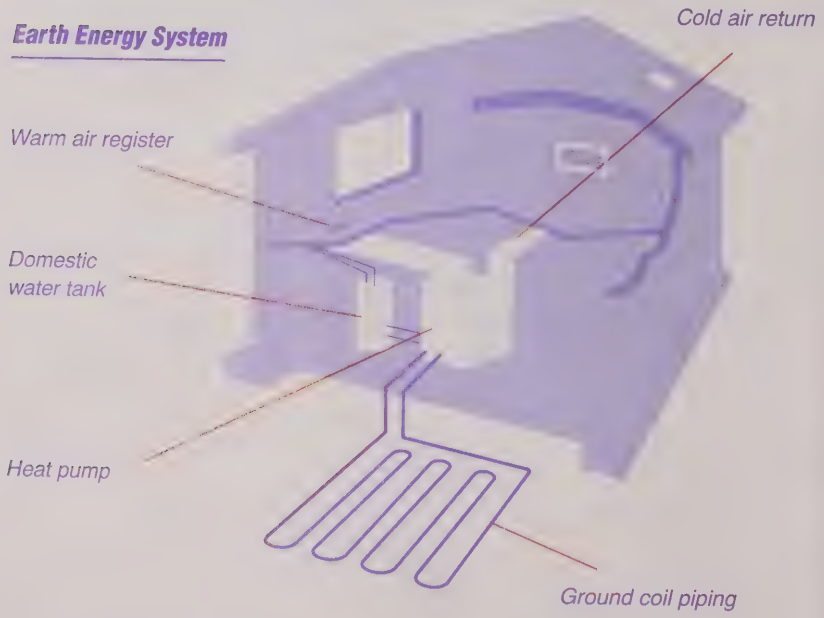
Electric resistance systems can consist of a central furnace or boiler, connected to an air or hot water distribution system, radiant panels embedded in the floor or ceiling or a baseboard space heating system. Electricity also powers heat pumps.

Heat Pumps

A heat pump is usually an electrically powered system that can either heat or cool by transferring heat from one place to another. During the heating season, a heat pump extracts heat from either the air, ground or water outside the house, and transfers it indoors. In the summer the direction of the heat pump flow is reversed, extracting heat from indoors and transferring it outdoors, to provide air conditioning. Heat pumps are sized in tons — 1 ton equals 12,000 British thermal units per hour (Btu/h) — and most home models range from 1.5 to 5 tons. There are three main types of heat pumps:

Earth energy systems

Also known as ground source heat pumps, these systems remove heat from the ground, ground water or surface water and use it to provide home heating. For summer cooling, the process is reversed. If desired, earth energy systems can be equipped to provide domestic hot water year round. Electric resistance heaters may be installed to provide supplementary heating for the coldest days.



Air source heat pumps

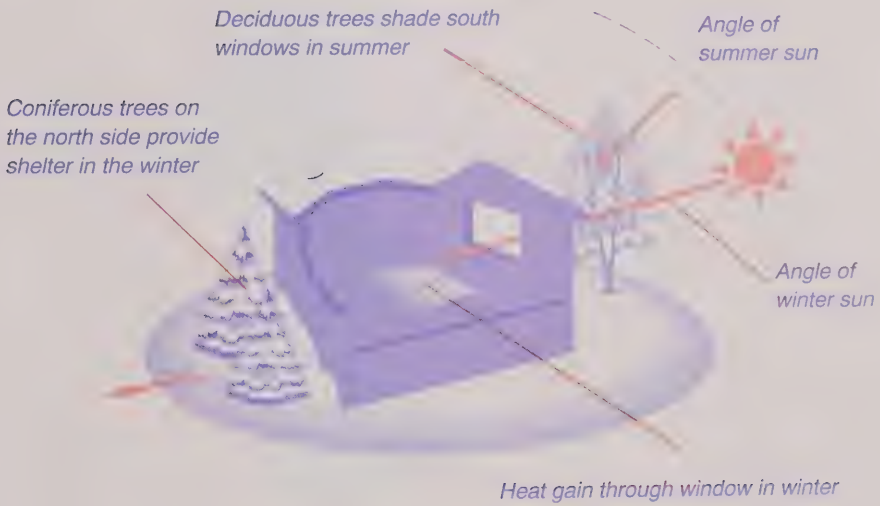
These most commonly used heat pumps can provide all the cooling requirements of a home but they need an auxiliary heating source during very cold weather. This can either be an electric resistance or a fossil fuel unit.

Bivalent heat pumps

A bivalent heat pump incorporates a gas burner into the outdoor section of an air source heat pump to provide efficient cold weather supplementary heat.

Solar Energy

Like wood, solar energy is a renewable resource. Solar heating does not involve the combustion of fossil fuels, so it does not produce environmentally harmful emissions. It can be as simple as south-facing windows serving as passive solar collectors. Passive solar heating is free and should be an important consideration in the design of homes. Homes built to high levels of energy efficiency and designed to make the most use of free solar heating can save hundreds of dollars a year on energy bills.



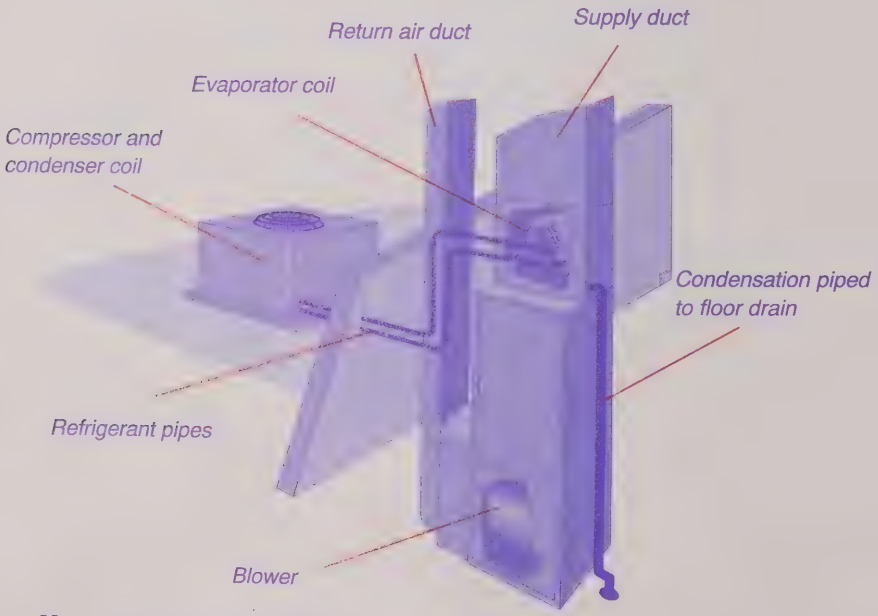
Air Conditioning Systems

Two types of units cool an entire house: a central air conditioner or a heat pump. If you only need to cool two or three rooms, window air conditioning units could be your most energy-conserving choice.

Central Cooling

If you decide you want to cool your entire house, you should consider which system to install — central air conditioning or heat pump — while reviewing your home's heating needs. Page 20 describes how a heat pump both heats and cools. An air conditioner is actually a heat pump that can only cool. Remember, your heating decisions can affect your cooling options.

Central Air Conditioner on a Forced Air System



Duct Work for Central Air

Duct work is generally needed to carry cool air throughout the house in a central air conditioning system. If you have a forced air heating system, as shown, you can usually use the same ducts for cooling. If you do not have duct work, you can look into installing it or consider new air conditioning technologies that have been developed for homes without ducts. These alternatives are costly so if you are considering them, investigate your options with your heating/cooling contractor.

Window Units

Window air conditioners are effective if you only need to cool a specific area of your home — say, a bedroom or a kitchen. And they will cost less to install than a central air conditioning system. If you don't have duct work, they might be your most practical choice. It is important to match the capacity of the window air conditioner with the size of the area to be cooled. Window units should either be covered in winter or, better still, removed to minimize heat loss.

Other Ways to Cool Your House

On all but the hottest, most humid days, the following measures will keep your home more comfortable.

Increase your home's insulation: it keeps out both heat and cold

Install ceiling fans to circulate air

Open windows in the evening and at night

If you're planning for the long term, plant trees that lose their leaves in the fall on the east, south and west side of your house

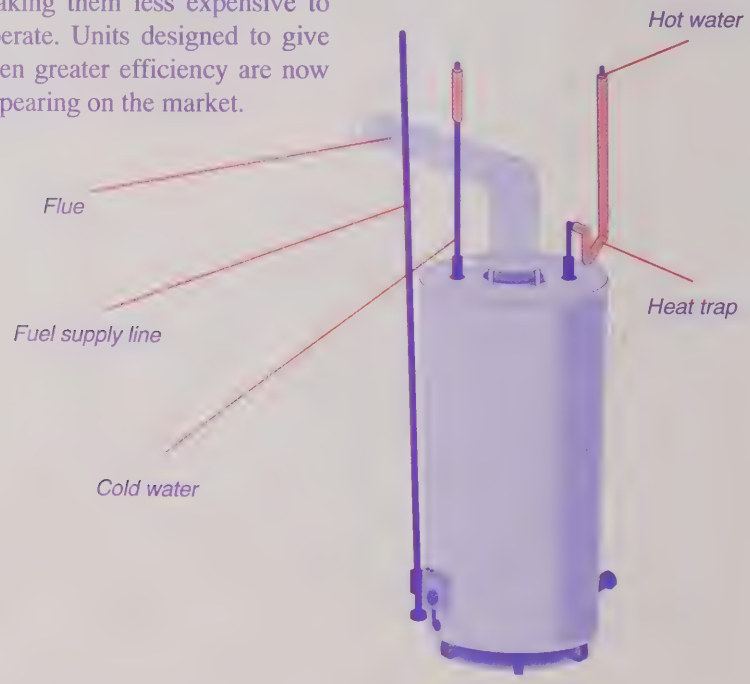
Close the drapes on south- and west-facing windows during sunny summer days

Hot Water Systems

There are several hot water options available to you. If you are thinking of changing fuels for home heating, you might be able to lower your operating costs further by also considering a new hot water heater. Check with your fuel supplier for more information.

Storage-Type Water Heaters

Most homes have storage-type water heaters in which water in a tank is heated by a gas or oil burner or by electric elements. Traditional storage heaters have been improved with such features as through-the-wall venting for combustion units and better insulation, making them less expensive to operate. Units designed to give even greater efficiency are now appearing on the market.



Instantaneous Water Heaters

Instantaneous water heaters which heat water as needed and have no storage tank are available, but not widely. They require little space, but they usually cost more than storage-type water heaters and more than one unit might be needed to meet your needs. For electric instantaneous water heaters, upgraded wiring is often necessary.

Integrated Hot Water Systems

Systems that combine space and water heating are becoming more popular. Some are based on a boiler that provides space heating and also heats water. Others are based on a storage tank water heater that provides hot water and space heating through either a forced air or hydronic distribution system. Earth energy systems can also combine efficient water heating and home heating or cooling. An integrated system usually performs at a higher overall efficiency than a separate water heater.

Solar Water Heaters

In solar water heaters, energy from the sun is collected by solar panels and transferred by circulating fluids to a storage tank. These heaters are typically used with an electric water heater, or one fuelled by oil, natural gas or propane, which acts as a back-up for overcast days.

Solar collector panels can be mounted on any unobstructed roof, wall or ground frame that faces between southeast and southwest. Solar water heaters are designed to provide between 35 and 75 per cent of your hot water needs, with the back-up providing the balance.

Comparison Shopping

Heating Systems

Distribution Systems

Possible Advantages	Possible Disadvantages
Forced Air	
• Rapid heat delivery • Compatible with central air conditioning, air cleaning, ventilation and humidity control • Circulates air to each room	• Duct work expensive as retrofit • Space required for duct work
Hydronic	
• Boiler more compact than forced air furnace • Temperature can be regulated from room to room • Can provide hot water	• May have higher installed costs • No duct work for central air conditioning
Space Heaters	
• Available in a range of models and sizes and choice of fuels • Convenient for homes with no basement or for heating home additions • Moderate installed cost • Can provide room-to-room (zoned) temperature control	• No duct work for central air conditioning • Will likely require more than one unit to heat house • Space heaters not currently regulated

Energy Source	Possible Advantages	Possible Disadvantages
Natural Gas	• Currently lowest-priced fuel • No fuel storage facilities needed	• Not available in all areas
Propane	• Wide range of products available that can use propane or be converted to natural gas	• Storage facilities needed for fuel • Currently a high-cost fuel
Oil	• Some older units can be upgraded by replacing burner • Currently costs less than electricity	• Currently costs more than natural gas • Space needed for a fuel storage tank
Wood	• Renewable resource • Can be cost-effective where low-cost wood is available • Aesthetically pleasing	• Storage area needed for fuel • Supplementary heating may be required • Requires effort and knowledge
Electricity	• No venting needed since there is no combustion • Compact heating units	• High cost of electricity • Likely requires 200 amp electrical service
Air Source Heat Pumps	• Lower operating cost than electric resistance heat • Also provides cooling	• Requires auxiliary heating source during coldest weather • More expensive to purchase than central air conditioning • Operating noise may disturb neighbours
Earth Energy Systems (Ground Source Heat Pumps)	• Most efficient system • Low operating costs • Can provide hot water	• Highest installed costs • Supplementary heating usually needed • Requires suitable site for ground or water loop

Cooling Systems

Possible Advantages	*Possible Disadvantages*
Room Air Conditioning	
• Duct work not required • Can target area to be cooled • Low installed cost • Portable	• Will likely increase interior noise • Limited cooling • Must be removed or covered in winter to minimize heat loss • Obstructs window
Central Air Conditioning	
• Easily added to forced air system to cool and dehumidify whole house	• Duct work expensive as retrofit • Might disturb neighbours • More expensive than room air conditioners
Heat Pumps	
• Also provides heating	• Higher installed costs than central air conditioning

Hot Water Heaters

Possible Advantages	*Possible Disadvantages*
Natural Gas	
• Currently lowest-priced fuel • Faster recovery time than electric	• Natural gas not available in all areas
Propane	
• Faster recovery time than electric • Equipment can be converted to natural gas	• Higher operating cost
Oil	
• Fastest recovery time • Smaller tank • Less expensive than electricity at current prices	• More costly than natural gas at current prices • Higher equipment costs
Electric	
• No venting need because there is no combustion • Tank can be located almost anywhere	• High operating cost • Slower recovery time
Earth Energy System	
• Low operating cost	• Only practical where earth energy system is used for heating
Solar	
• Renewable energy source • No-cost fuel	• Requires back-up with conventional fuel • High equipment costs
Integrated Hot Water Systems	
• Only one system to purchase and maintain for both home and water heating • May provide higher water heating efficiency	• A breakdown may disable both home and water heating

Replacing Your System

You've looked at all your options, considered the pros and cons of different equipment and fuels and compared installation and operating costs in the Energy Calculator. Now you're ready to replace your existing system. It's time to select a contractor.

1. Look for a registered contractor

Your contractor will supply and install your equipment. Installation of fossil-fuelled appliances must be performed by a contractor who is registered with the Fuels Safety Branch, Ontario Ministry of Consumer and Commercial Relations, and must pass appropriate inspections. Proper installation is essential for the safe, efficient and economical operation of your system.

Electric equipment must be installed by a licensed electrician.

In the case of wood heating systems, look for registration with the Association of Wood Energy Technicians of Ontario. For earth energy systems, look for accreditation by the Canadian Earth Energy Association (CEEA) and insist on conformance with current CEEA endorsed installation practices and all environmental regulations.

2. Get estimates from several contractors

Prices can vary significantly among contractors. Ask each firm for a written statement covering the following items:

- the total cost and a listing of all necessary work including improvements to the existing system and the provision of combustion air if applicable
- heat loss/gain analysis (see item 4)

- the size and seasonal efficiency of the unit
- responsibility of the contractor or the homeowner for:
  - obtaining permits and paying related fees
  - removing and disposing of old equipment
  - arranging for such things as installation of gas supply
  - arranging necessary inspections
- a work schedule and completion date
- guarantees, warranties and service contracts
- terms of payment
- evidence of registration with the Fuels Safety Branch of the Ontario Ministry of Consumer and Commercial Relations, the Association of Wood Energy Technicians of Ontario, the Canadian Earth Energy Association and or an electrician's licence as appropriate.

3. Make your selection

Use costs (both installed and operating), work schedule, warranties and service as the basis for your decision.

Ask the contractors you are considering for references, and don't be shy. Ask previous customers what they think about the contractors, fuel suppliers and the options you are looking at.

4. Choose the right size equipment

In order to correctly size new heating and cooling equipment, your contractor must analyze how much heat is lost from your home in winter and gained in summer. Ask for this heat loss/gain analysis in writing, including the method used to do the calculation. This calculation should take into consideration the size of your house, its level of insulation and the condition of windows and doors. If the heat loss and gain is significant and you haven't already taken steps to increase the energy efficiency of your house (see page 4), now is the time to do it.

Avoid the temptation to simply choose the same size equipment that already exists in your house without doing a heat loss/gain analysis. Your home has likely been altered over the years and the system might even have been the wrong size at the start. An oversized unit will usually operate below its best efficiency, and both oversized and undersized units can adversely affect the comfort of your home.

If you are installing an air source heat pump, keep in mind that Ontario homes have heavier heating than cooling demands. The rule is to size the heat pump based on cooling rather than heating needs so that it isn't oversized for the cooling job it has to do.

Changing Your Water Heater

Size is an important consideration when selecting new hot water equipment. The larger your family, the more hot water you need. By practising water conservation — for example, by installing energy-efficient showerheads and aerators on taps and using cold water in your washing machine — you can substantially reduce your hot water usage. The tables on the next two pages will help you work out your total household hot water consumption and choose the right size tank for your household needs.

Your Family's Daily Hot Water Use

	Litres	Gallons
Bath (1/2 full)	34-43	8-10
Dishwasher*	42-65	9-13
Dishwashing by hand*	7-16	1.5-3.5
Whirlpool bath	400-1200	90-270
Personal use (per person, per day) (other than baths and showers)	15	4
Clothes (per load)		
hot wash/warm rinse	135	30
hot wash/cold rinse	87	19
warm wash/cold rinse	41-54	9-12
cold wash/cold rinse	0	0
Shower (with standard showerhead)		
5-minute shower	54	12
10-minute shower	110	24
15-minute shower	160	36
Shower (with energy-efficient showerhead)		
5-minute shower	13	3
10-minute shower	27	6
15-minute shower	40	9

Source: Ontario Hydro

** A fully loaded dishwasher is likely to use less water per dish than if the dishes are washed by hand.*

Choose The Right Size Water Heater

Tank Capacity	Family Size	House Characteristics
Electric* hot water tank . . .		
135 litres (30 gallons)	up to 2	Vacation cottage or similar, no dishwasher or automatic clothes washer. Low hot water use
180 litres (40 gallons)	up to 3	Up to 3 bedrooms, 2 bathrooms, moderate use, automatic dishwasher or clothes washer
270 litres (60 gallons)	4-7	2 or more bathrooms, 3-5 bedrooms, normal use, automatic dishwasher and/or clothes washer
Gas hot water tank . . .**		
150 litres (40 gallons)	up to 3	Up to 3 bedrooms, 2 bathrooms, moderate use, automatic dishwasher and/or clothes washer
190 litres (50 gallons)	up to 5	Up to 4 bedrooms, 2 bathrooms, moderate use, automatic dishwasher and/or clothes washer
225 litres (60 gallons)	up to 8	2 or more bathrooms, 3-5 bedrooms, normal use, automatic dishwasher and/or clothes washer
Oil hot water tank . . .**		
120 litres (32 gallons)	up to 8	Can handle very heavy use

* Sized in Imperial gallons

** Sized in US gallons

Installing a Hot Water Tank

1. Call your local fuel supplier or contractor

Ask for the efficiency ratings of the models you are considering (see also the Efficiency Rating section, page 48). When you have selected a unit just big enough to meet your household needs, your fuel supplier or contractor can arrange for a qualified serviceperson to install the water heater.

2. Save on your hot water bill

If you have an electric hot water tank, wrap it in an insulating jacket. Make sure the jacket is certified for use on your heater and is properly installed.

Insulate both the hot and cold water lines within two metres of the tank and consider installing a heat trap (see diagram, page 26). Be careful not to insulate the pipes within 15 cm of the flue of a fossil-fuelled tank.

Advice and Information

Often the most difficult part of any project is getting started — knowing where to get advice and information.

1. Energy Conservation and Efficiency

This guide is one of a series of free publications produced by the Ministry of Environment and Energy to help consumers make informed decisions about home energy matters. Other booklets in this series include:

Energy-Efficient Appliances and Lighting
Energy-Efficient Windows and Doors
Energy-Efficient Resale Homes

Other Ministry of Environment and Energy publications that will help you make your home more energy-efficient and save on your energy bill are:

Improve Fireplace Efficiency
Caulk and Weatherstrip
Insulate Basements
Cut Your Energy Bills Up to 20%

For free copies of these publications and information on Ontario's Energy Efficiency Act, contact:

Ontario Ministry of Environment and Energy
Consumer Publications
Telephone in Toronto: 327-1234
Outside Toronto call toll-free: 1-800-ENERGY1

Energy, Mines and Resources Canada also offers a variety of free publications on home energy conservation and efficiency. To obtain them, write to:

Energy Publications
Energy, Mines and Resources Canada
15th Floor, 580 Booth Street
Ottawa, Ontario K1A 0E4
Telephone in Toronto: 973-5814

2. *Energy Sources and Fuels*

If you have any further questions about fuel or equipment choice, contact the following:

Electricity

Ontario Hydro has a selection of free publications on home energy conservation and efficiency. For more information, call **Ontario Hydro** toll-free throughout Ontario at 1-800-263-9000 or call your local municipal electric utility.

For information on earth energy systems contact:
Canadian Earth Energy Association
2978 Barlow Crescent
R.R. 1, Dunrobin,
Ontario KOA 1TO
(613) 832-1854

Natural Gas

For more information, contact your local natural gas utility.

Propane

Contact your local propane dealer or:
Propane Gas Association of Canada
1155 North Service Road West, Unit # 11
Oakville, Ontario L6M 3E3
(416) 827-8505

Oil

Contact your local heating oil supplier or:
Canadian Oil Heat Association
115 Apple Creek Blvd., Suite 208
Markham, Ontario L3R 6C9
(416) 946-0264

Solar Energy

Renewable Energy Technologies
Energy, Mines and Resources Canada
9th Floor, 580 Booth Street
Ottawa, Ontario K1A 0E4
(613) 996-6220

Solar Energy Society of Canada Inc. (SESCI)
301 Moodie Drive, Suite 420
Ottawa, Ontario K2H 9C4
(613) 596-1067 Fax (613) 596-1120

Wood

For information on wood suppliers check the Yellow Pages under firewood. For information on cutting your own firewood, contact your local **Ministry of Natural Resources** office.

3. Future Fuel Costs

Energy cost forecast information is available from the Ontario Ministry of Environment and Energy at the phone number given on page 38.

4. *Home Air Quality*

For information on biological and chemical contaminants in the home, request a copy of:

Breathe Easy, a Resource Guide to "Clean Air" and *Housing and Air Quality Checklist for the Home* from

Canadian Housing Information Centre
Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa, Ontario K1A 0P7
(613) 748-2367

For more information on ventilation and humidity control, contact the **Ministry of Environment and Energy** (phone number on page 38) for a free copy of:

Provide Fresh Air and Control Humidity in a Tighter House

5. *Home Heating Safety*

For information on the use of natural gas, oil or propane contact your local fuel supplier or:
Fuels Safety Branch
Ontario Ministry of Consumer and Commercial Relations
4th Floor, Shipp Centre West Tower
3300 Bloor Street West
Etobicoke, Ontario M8X 2X4
(416) 234-6030

For electrical safety and inspection information, contact your local Ontario Hydro Inspection Office or call 1-800-263-9000.

For information on wood safety, contact your municipal building or fire department, or a WETT certified retailer, installer or chimney sweep. For further information, contact:
Canadian Wood Energy Institute
24 Lake Street, P.O. Box 160
Killaloe, Ontario K0J 2A0
(613) 757-3600

Glossary of Terms

Here is a quick review of terms you'll come across in this guide and in talks with your contractor, local utility or fuel supplier.

Air source heat pump - a heating/cooling unit that transfers heat in either direction between the air outside a home and the indoors.

Air supply for combustion - the air a furnace, boiler or space heater requires to burn fuel.

Annual fuel utilization efficiency (AFUE) - see the Efficiency Ratings section, page 46.

Aquastat - a thermostat that controls the water temperature in a boiler.

Boiler - the heating unit used with a hot water (hydronic) distribution system.

British thermal units per hour (Btu/h) - a unit of heat used to measure the heating capacity of heating equipment.

Central air conditioner - a unit that cools an entire house by removing heat from the inside air and releasing it outside.

Coefficient of performance (COP) - see the Efficiency Ratings section, page 46.

Controls - devices such as a thermostat that regulate a heating or cooling system.

Conventional gas furnace or boiler - a gas heating unit with an annual fuel utilization efficiency (AFUE) less than 70 per cent. It exhausts through a masonry chimney or metal "B" vent.

Cost-effective heating/cooling system - one that produces good value for money after all costs (purchase, installation, financing and energy charges) are considered.

Distribution system - the component of a heating or cooling system that delivers warmed or cooled air, or warmed water, to the living space.

Domestic hot water - hot water used for household purposes.

Earth energy system (ground source heat pump) - a heat pump that removes heat from the earth or ground water in cold weather and transfers it to the house through an underground piping system. The process reverses in warm weather and heat is transferred to the ground.

Electrical resistance heating - heat produced by passing electricity through a resistor.

Energy efficiency ratio (EER) - see the Efficiency Ratings section, page 46.

Energy factor (EF) - see the Efficiency Ratings section, page 46.

Flame retention head burner - a higher-efficiency burner in an oil furnace. It produces a hotter flame and operates with a lower air flow, thus reducing heat loss up the chimney.

Forced air - a distribution system in which a fan circulates air from the heating or cooling unit to the rooms through a network of ducts.

Fossil fuel - a naturally occurring carbon or hydrocarbon fuel such as natural gas, propane and oil, formed by the decomposition of prehistoric organisms.

Furnace - a heating unit that uses a forced air distribution system.

Ground source heat pump - another term for an earth energy system.

Heat exchanger - a structure that transfers heat from the hot combustion gases in a furnace to the circulating household air or, in a boiler, to the circulating hot water.

Heat recovery ventilator (HRV) - a device used in central ventilation systems to reduce the amount of heat that is lost as household air is replaced with outside air. As fresh air enters the house, it passes through a heat exchanger heated by the warm outgoing air stream and is preheated.

Heating seasonal performance factor (HSPF) - see the Efficiency Ratings section, page 46.

High-efficiency (condensing) furnace or boiler - a heating unit with an annual fuel utilization efficiency (AFUE) of 90 per cent or more. It has a second stainless steel heat exchanger that removes additional heat from exhaust gases. Water vapour condenses as the exhaust cools. The unit vents through a narrow plastic wall pipe instead of a chimney.

Hot water distribution - see hydronic system.

Hydronic system - a distribution system in which hot water is circulated through a network of pipes to radiators, wall panels or an under-floor heating system.

Installed cost - the total of the purchase price and the installation costs of equipment.

Instantaneous water heater - a device that heats water as required but does not store it. The unit is usually located near the point of use.

Kilowatt - a unit of electrical power used to measure the heating capacity of electric equipment. One kilowatt (kW) equals 1,000 watts (W).

Mid-efficiency natural gas or propane furnace or boiler - a gas heating unit with an annual fuel utilization efficiency (AFUE) of 78 to 82 per cent. Most models exhaust through the basement wall.

New oil furnace - has flue gases that may be exhausted through a chimney or a side wall vent. Efficiencies (AFUE) range from 78 to 86 per cent.

R-2000 - an energy efficiency standard for new homes under a voluntary government-industry program. Builders meet the standard by offering an integrated package of upgrades. The package includes high insulation levels, air-tightness, heat recovery ventilation and efficient heating/cooling systems. If a home meets all the requirements of the program, including an actual test of the house after it is built, it is certified as meeting the standard.

Retrofit - replacement of one or more components of an existing system.

Seasonal efficiency - a performance rating that considers the heat (or 'cool') actually delivered to the living space, the total energy available in the fuel consumed, and the impact the equipment itself has on the total heating or cooling load through an entire heating season. HSPF, AFUE, SEER and EF are seasonal efficiency ratings. (See also the Efficiency Ratings section, page 46.)

Seasonal energy efficiency ratio (SEER) - see the Efficiency Ratings section, page 46.

Setback thermostat - a programmable thermostat with a built-in timer. You can adjust it to vary household temperature automatically.

Space heater - a heating unit that supplies heat directly to the room where it is located and is not connected to a distribution system.

Steady-state efficiency - see the Efficiency Ratings section, page 46.

Storage-type water heater - a tank that heats and stores hot water.

Ton - a measure of the cooling capacity for central air conditioners and heat pumps. (1 ton = 12,000 Btu/h)

Watt - see kilowatt.

Efficiency Ratings

Before you use the Energy Calculator tables, take a few moments to familiarize yourself with the efficiency ratings you'll find on various pieces of equipment.

Heating Equipment

Boilers and Furnaces

Rating to look for: AFUE

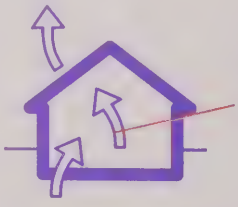
The annual fuel utilization efficiency (AFUE) of furnaces and boilers measures their performance over a typical heating season. It takes into account things like on-and-off cycles and heat loss through the chimney or vent, and is the most useful furnace and boiler rating available. The higher the rating, the more efficient the unit.

There is a second efficiency rating for furnaces and boilers and it is known as a steady-state efficiency. It is higher than an AFUE rating but it's not as helpful. It measures the equipment's performance after it has been running a short while and all components have reached their normal operating temperature. The steady-state efficiency of furnaces and boilers is arrived at by comparing the amount of heat that's available in the fuel to the amount they can convert into usable heat.

An example of 78% AFUE

22 units lost as hot gases, water vapour, pilot light heat and heated air up the chimney

100 units of energy purchased



Net 78 units of useful heat after off-cycle losses deducted

$$\text{Annual fuel utilization efficiency (AFUE)} = \frac{\text{Amount of heat reaching the house during operation} - \text{Heat loss during off cycle}}{\text{Amount of heat available in fuel}}$$

Wood-Burning Appliances

Advanced equipment which is certified as meeting the EPA or CSA-B415 emissions standard exceeds 60 per cent and averages 70 per cent efficiency. Conventional wood-burning appliances which are not certified as low emission average 50 per cent efficiency, with the range being 35-70 per cent. Although some wood-burning equipment is specifically certified for efficiency, most is not.

Also keep in mind that most wood-burning appliances are manually operated, not automatic, and so the practices of the operator will affect the efficiency actually achieved.

Heat Pumps
Ratings to look for: COP, HSPF

Earth energy systems are rated for heating efficiency by comparing them to electric resistance heat. The measurement used is called the coefficient of performance — COP — and is arrived at by dividing the heat output by the energy input. Since the COP of an electric resistance heater is 1.0 — which means that the same amount of energy that goes into it as electricity comes out as heat — any rating higher than 1.0 means that for the same amount of electricity going in, more heat comes out. Look for a COP of 3.0 or more at 10°C entering water temperature.

The heating efficiency rating for an air source heat pump is called the heating seasonal performance factor (HSPF). This is arrived at by dividing the total heat provided during the season (in Btu) by the total energy consumed by the system (in watt-hours). The higher the rating, the more efficiently the heat pump operates over the entire heating season. Look for a HSPF of over 5.9.

Cooling Equipment

Air Conditioners and Air Source Heat Pumps
Rating to look for: SEER

A SEER rating, which stands for seasonal energy efficiency rating, tells you the cooling energy efficiency of air conditioners and air source heat pumps. A SEER rating is arrived at by dividing the total cooling provided during the season (in Btu) by the total energy consumed by the system (in watt-hours). In general, SEERs for new central air conditioners and air source heat pumps currently range from 9 to 15. The minimum requirement in Ontario is 9.0. For room air conditioners, the range is 6 to 12.

Earth Energy Systems
Rating to look for: EER

If you want to know how efficiently an earth energy system can cool, look for the letters EER, which stand for energy efficiency ratio. EER ratings are arrived at by dividing the cooling output of the ground heat pump (in Btu/hour) by the power input (in watts). Look for an EER of at least 10.5.

Hot Water Equipment

Storage-type Hot Water Heaters

An energy factor (EF) is used to rate the energy efficiency of storage-type hot water heaters. Both on-cycle efficiency and off-cycle losses are taken into account, which makes it a seasonal rating. The higher the EF, the more efficient the unit. You can expect the following energy factor ranges for new storage-type water heaters:

- gas 0.56 to 0.86
- electric 0.87 to 0.98
- oil 0.53 to 0.65

A storage-type water heater added to an earth energy system will have an energy factor of 2.7 to 3.1.

TO USE CALCULATOR

Method 2: More Accurate Costs

For this method you must calculate your annual heating costs. If you haven't kept your bills, call your fuel supplier for the information. Your bill most likely combines both space heating and hot water costs. To discover your true heating bill for the year, you must deduct your hot water costs. If you have electric heat, your bill also includes lighting and appliance costs.

If you have a gas or oil furnace and water heater, use Table 4 to find approximately how much money your family spends in a year on hot water, then deduct this from your total annual gas or oil bill to find your home heating energy cost.

If you have electric heating, assume that 60 per cent of your annual electricity bill is for home heating.

How to use the tables with Method 2

1. Using the column for your current heating/cooling system in Table 1, 2 or 3, find the figure that most closely matches your annual heating cost. It might be in a row that relates to a different house type or heating zone than yours, but this row will be the most accurate for your house and lifestyle and this will be **your row**.

2. Using Table 2 for heating only and Table 3 for heating and cooling, **and remaining in your row**, look across that row at the comparable costs of new equipment.

What If?

What if you live in an older detached house, approximately 1,500 sq. ft. in Zone 1 and your heating bill most closely matches an older detached house of the same size in Zone 3? What does that tell you? Perhaps you're spending more money on energy than you might need to. Is your home as energy-efficient as you can make it? Do you practise energy efficiency in your lifestyle? If your answer to both of these questions is "No," and you plan no changes in either area, then your energy bill will always be higher than it could be even if you install new, more efficient heating equipment.

Step 2: Ask Yourself . . .

- ☐ Am I interested in heating only, or do I want to check out heating and cooling options?
- ☐ What fuels are available in my area?
- ☐ I'm renovating — what limits does my present heating system place on my choices?
- ☐ I'm having a home built — am I aware of all the options my builder can offer?
- ☐ Do I plan to live in this house long enough to make this investment worthwhile?
- ☐ How will I finance new equipment and installation?

THE ENERGY CALCULATOR

A Word About . . .

CALCULATIONS

Even though the costs you determine using Method 2 are more accurate than the costs you can find through Method 1, they are still not entirely accurate. That's because the tables are based on typical equipment efficiencies and approximate fuel rates at the time of printing. For greater accuracy, you should always confirm the efficiency of the equipment you are considering and the fuel rates charged by your supplier. Then you can fine-tune the annual energy costs in the tables to your situation.

March 1993

Energy Prices

Energy prices vary (particularly for wood), so you should always determine your current local rates to see if you should adjust the costs in the tables for your situation. The prices used for the tables, which are Ontario averages for January, 1993 and include GST, are:

Electricity	8.2¢/Kilowatt-hour
Natural Gas	23¢/Cubic Metre
Oil	37¢/Litre
Propane	40¢/Litre
Wood	$150/Cord (full - 4'x4'x8')

For wood, the table calculations are based on burning hardwood. Softwood is just as suitable for use as a fuel, but keep in mind that it takes about one-and-two-thirds cords of softwood to equal the energy content of a cord of hardwood.

Installed Cost

While an attempt is made to give some notion of the installed cost of the various options, each situation is unique and your decisions should be based on actual quotes for the work you are considering. The costs in the tables include an allowance for any typically required fuel lines or tanks and connections to an existing distribution system, but do not include the cost of the actual distribution system. You should also obtain more than one quote for each option you are considering.

The quoted wood costs are for a decorative stove and a factory-built chimney. Efficient fireplace costs are higher.

Maintenance Costs

Maintenance needs and costs can vary significantly amongst the options you are considering and also from one equipment or fuel supplier to the next. When you get your quotes, also ask for quotes on standard maintenance packages and any extended warranty plans that are available. Consider these costs in arriving at a total annual operating cost.

Efficiency Ratings Used for Calculating the Tables

In most cases, the efficiency level used in calculating the tables is representative of the published ratings that are described in the Efficiency Ratings section.

The published ratings cannot be used so directly in the case of earth energy systems because the field conditions for those systems operating in Ontario usually differ significantly from the fixed conditions used to establish the ratings. This, in turn, causes the average field operating efficiency for that equipment to differ significantly from the published ratings. The 2.7 COP used for earth energy systems in the tables is based on studies of average seasonal operating efficiencies for these systems in Ontario homes.

Fan Energy

The methods used to determine the AFUE of fossil-fuelled equipment do not consider the electricity used by that equipment. This component is quite significant, so in the tables it is assumed that 900 kWh of electricity per year is used by that equipment.

Let's Go! →

Step 1: Start Here!

HOW THE ENERGY

You can use the Energy Calculator in two ways to help you make the most cost-effective decision possible when you upgrade or replace equipment or switch to another fuel:

1. You can find approximate costs by looking in the row of figures that relates to your heating zone and house type. (See Method 1.)

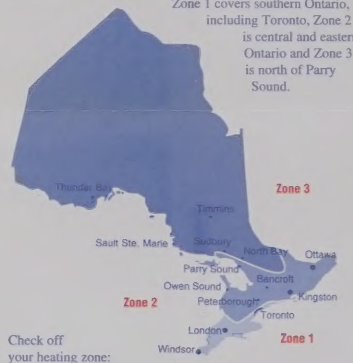
2. If you are able to determine your annual heating cost, you can use the tables to find a more accurate, comparative cost. Locate the figure that most closely matches your cost for your type of equipment, and then use that row to do your energy cost comparison. (See Method 2.)

Method 1: Approximate Costs

Collect two pieces of information: the heating zone in which you live and the size and type of your home.

1st: Find your heating zone

Ontario can be divided into three main heating zones. Zone 1 covers southern Ontario, including Toronto, Zone 2 is central and eastern Ontario and Zone 3 is north of Parry Sound.



Check off your heating zone:

Zone 1 ☐ Zone 2 ☐ Zone 3 ☐

2nd: Identify your home size and type

Check off the description that most closely matches your home (square footage does not include basement):

- ☐ Town or row house (inside unit) approx. 1,000 sq. ft.
- ☐ Semi-detached house approx. 1,200 sq. ft.
- ☐ Detached house approx. 2,000 sq. ft.
- ☐ Detached house (pre-1975) approx. 1,500 sq. ft.

How to use the tables with Method 1

Using the row of figures for your house type and heating zone in Tables 1, 2 and/or 3, you can compare typical annual energy costs for a number of equipment options with the typical energy cost for your present equipment.

You can see how this method can only give you approximate costs. Your annual heating bill might be higher or lower than the average given, and this will affect the amount of savings you can expect from new equipment. The level of insulation, caulking and weatherstripping in your home, as well as your lifestyle, all affect the bottom line.

Step 3: Determine Your Options!

Tony & Sue: Method 1

Tony and Sue live in Scarborough, Ontario. They own a 1,700 sq. ft. detached home that was built in the 1950s. It has a natural gas furnace and water heater. The furnace is old and needs to be replaced.

After reading this guide, Tony and Sue agree that they have a number of alternatives for replacing their furnace. They decide not to install central air conditioning.

The couple use Method 1 and identify their heating zone as Zone 1 and their home as a detached house (pre-1975) approximately 1,500 sq. ft. They use Table 1 to find out what the annual heating energy bill should be for their type of home heated by an older natural gas furnace. Looking across the Zone 1 row in their house type, they read:

Next, they turn to Table 2 to compare annual costs of several new heating options. Looking across the row of figures for the same house type and zone, they read:

They decide not to consider switching to another fuel.

Tony and Sue then check the installed cost range figures at the bottom of each column on Table 2. This covers the cost of replacing an existing gas furnace with another, with no gas piping required. They read:

The couple decide to get quotes on mid-efficiency and high-efficiency gas furnaces to see how their actual installed costs compare. As soon as they can weigh these costs against the annual energy costs of the two options, they can then make their final choice.

John & Mary: Method 2

John and Mary live just south of Ottawa with their two children. They own a 2,000 sq. ft. two-storey detached home that was built in 1980. It has electric baseboard heat and an electric water heater. The couple want to see if they can reduce their energy costs.

After reading this guide, they realize that switching to another fuel will require the installation of a distribution system. Natural gas is not available in their area. They decide to investigate propane and oil as fuels, and forced air and hot water as distribution systems. Their neighbours heat their home with wood at no cost for the wood, but John and Mary decide that wood heating is not practical for their lifestyle. They also decide not to install central air conditioning.

The couple decide to use Method 2 to calculate costs. Their annual electricity bill is $3,450, so they estimate their heating cost at $2,070 (60 per cent of $3,450). They also check their fuel rates and find that they are close to those shown in the tables. Turning to Table 1 they find that their heating cost of $2,070 puts them midway between the Zone 1 and Zone 2 rows for their house type.

Next they review their options in Table 2. Looking across the Zone 1 and Zone 2 rows for their house, they figure out improvements that different options might make to their annual heating costs by taking an average between the Zone 1 and Zone 2 figures.

Annual Energy Cost	Zone 1	Zone 2	Average
Mid-efficiency propane furnace or boiler	$1,640	$2,030	$1,835
High-efficiency propane furnace or boiler	1,420	1,760	1,590
Oil furnace or boiler	1,000	1,230	1,115

The couple also note on Table 3 that a ground source heat pump would heat and cool their house for $865, so they decide to investigate this option.

Because the installation of a distribution system can be highly variable, John and Mary decide to get quotes for the installation of the following:

- ✓ oil furnace with duct work
- ✓ oil boiler with water pipes and radiators
- ✓ earth energy system with duct work

They are careful to specify that they want the interior completely refinished where required after installation of the distribution system. They also specify that landscape repairs must be included in the cost of the earth energy system installation.

John and Mary also note from Table 4 that they could save money on water heating costs either by adding a solar system to their electric tank, switching to oil, or heating their water with an earth energy system. They decide to get prices for these options at the same time.

With actual installed costs to weigh against the annual energy costs of the various options, they can then make their final choice.

1 Annual Heating Costs for Older Systems ($)

House Type	Zone	Electric Resistance 100% Efficiency	Natural Gas Furnace or Boiler 63% AFUE	Oil Furnace or Boiler 65% AFUE	Propane Furnace or Boiler 63% AFUE
Town or Row Inside Unit 1,000 sq. ft.	1	680	360	520	820
	2	910	460	660	1070
	3	1140	560	810	1320
Semi-Detached 1,200 sq. ft.	1	1250	600	880	1440
	2	1710	800	1180	1940
	3	2160	990	1470	2440
Detached House 2,000 sq. ft.	1	1820	840	1250	2070
	2	2280	1040	1540	2560
	3	2730	1230	1840	3060
Older Detached House (pre-1975) 1,500 Sq.Ft.	1	2510	1130	1690	2810
	2	3190	1420	2130	3560
	3	3760	1660	2500	4180

2 Annual Heating Costs for New Systems ($)

House Type	Zone	Electric Resistance 100% Efficiency	Natural Gas Furnace 80% AFUE	Natural Gas Furnace or Boiler 93% AFUE	Oil Furnace or Boiler 83% AFUE	Propane Furnace or Boiler 80 % AFUE	Propane Furnace or Boiler 93% AFUE	Wood Stove (Conventional) 50 % Eff.	Wood Stove (Advanced) 70% Eff.
Town or Row Inside Unit 1,000 sq. ft.	1	680	300	270	420	660	580	370	280
	2	910	380	330	530	860	750	470	350
	3	1140	450	400	650	1050	920	560	420
Semi-Detached 1,200 sq. ft.	1	1250	490	430	710	1150	1000	610	460
	2	1710	640	560	940	1540	1340	810	600
	3	2160	790	690	1170	1940	1680	1010	740
Detached House 2,000 sq. ft.	1	1820	680	600	1000	1640	1420	860	630
	2	2280	830	730	1230	2030	1760	1050	770
	3	2730	980	860	1460	2430	2100	1250	910
Older Detached House (pre-1975) 1,500 sq. ft.	1	2510	910	790	1340	2230	1930	1150	840
	2	3190	1140	990	1690	2820	2440	1450	1050
	3	3760	1330	1150	1970	3310	2860	1690	1230
Installed Cost Range ($)	Furnace	2000-2700	2700-3600	1600-2500	3000-3700	3700-4600	2400-2800	2600-3000	
	Boiler	3500-4500	4500-5500	3500-4500	4500-5500	5500-6500			

3 Annual Heating and Cooling Costs for New Systems ($)

House Type	Zone	Air Conditioner 9 SEER Cooling Only	Air Conditioner 9 SEER & Natural Gas Furnace 80% AFUE	Air Conditioner 9 SEER & Natural Gas Furnace 93% AFUE	Air Conditioner 9 SEER & Oil Furnace 83% AFUE	Air Conditioner 9 SEER & Propane Furnace 80% AFUE	Air Conditioner 9 SEER & Propane Furnace 93% AFUE	All Electric Heat Pump 9 SEER & 6.5 HSPF	Earth Energy System 2.7 COP*
Town or Row Inside Unit 1,000 sq. ft.	1	40	350	310	460	710	620	400	300
	2	40	410	370	570	890	780	510	370
	3	20	470	420	670	1070	930	620	440
Semi-Detached 1,200 sq. ft.	1	90	580	520	790	1240	1090	750	550
	2	60	700	620	1000	1610	1400	960	690
	3	40	830	730	1200	1970	1710	1170	840
Detached House 2,000 sq. ft.	1	120	800	720	1120	1770	1550	1080	790
	2	100	930	820	1320	2130	1860	1300	940
	3	60	1050	920	1520	2490	2160	1500	1070
Older Detached House (pre-1975) 1,500 sq. ft.	1	160	1070	950	1500	2390	2090	1480	1080
	2	120	1260	1110	1810	2940	2560	1800	1300
	3	80	1400	1230	2050	3390	2940	2060	1470
Installed Cost Range ($)		1600-2400	3700-4900	4400-5800	3300-4700	4700-5900	5400-6800	4500-6000	6000-12000

* See notes on efficiency ratings, page 47.

4 Annual Water Heating Costs ($)

People in Household	Earth Energy System 2.7 COP*	Electric 0.89 Energy Factor	Natural Gas 0.57 Energy Factor	Oil 0.57 Energy Factor	Propane 0.57 Energy Factor	Solar with Electric Back-up
One	80	230	100	150	250	90
Two	100	310	130	200	330	120
Three	130	410	170	270	440	160
Four	160	490	200	320	520	190
Six	210	640	270	420	690	260
Installed Cost Range ($)	300-500 (add-on to EES)	300-400	400-600	600-900	500-700 (not incl. fuel tank)	2500-3200
Monthly Rental ($)	not available	4-6	4-16	4-16	10	not available

* See notes on efficiency ratings, page 47.

→ See Notes on Back

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